Geophysical Research Abstracts
Vol. 18, EGU2016-9433, 2016
EGU General Assembly 2016

Understanding future projected changes and trends in extreme precipitation and streamflow events in ten Polish catchments

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The aim of the study is to investigate methods of trend detection in hydro-climatic high and low indices using novel and conventional tools, for future climate projections in the periods 2021–2050 and 2071–2100. The climate meteorological projections are obtained from regional climate models or/and global circulation models forced with IPCC SRES A1B, RCP4.5 and RCP8.5 emission scenarios. The study area includes ten catchments in Poland. The catchments have diverse hydro-climatic conditions. They are covered mostly by forest and are semi-natural. The flood regime of all the catchments is driven either by rainfall and/or snow-melt. Streamflow projections are provided by running the HBV hydrological model, coupled with climate models for the catchments. The trends are analyzed using a conventional Modified Mann Kendall statistical approach, a time frequency approach based on wavelet discrete transform (DWT) and the Dynamic Harmonic Regression (DHR) method. We address the problems of auto-correlation, seasonality and inter-annual variability of the derived indices. A Modified Mann Kendall (MMK) method is applied to cope with the autocorrelation of the time series. The DHR method is based on the unobserved component approach. Together with estimates of the components, the uncertainty of the estimates is also calculated. The results of the DHR analysis (trend) are compared with the calculated MMK and DWT trends. Among other indices we study the temporal patterns of the Standardized Precipitation Index (SPI), Standardized Runoff Index (SRI) and Standardized Evapotranspiration Index (SPEI), as well as Maximum Annual Flows and Minimum Annual Flows. The results indicate that changes in the trends of the projected indices are more conservative when DHR methods are applied than conventional trend techniques. The wavelet-based approach is the most subjective and gives the least conservative trend estimates. Trends indicate an increase in the amount of precipitation, followed by increased flows, with strong seasonal changes. The results of the DHR analysis show that hydro-climatic extremes are characterized by oscillatory behavior at different time scales.

Acknowledgements: This work was supported by the project CHIHE (Climate Change Impact on Hydrological Extremes), carried out in the Institute of Geophysics Polish Academy of Sciences, funded by Norway Grants (contract No. Pol-Nor/196243/80/2013). The climate, water level and flow data were provided by the Institute of Meteorology and Water Management (IMGW), Poland.